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(54) Disinfectant dry cleaning

(57) Textile materials are cleaned and disinfected by tumbling in an organic solvent in the presence of a disinfectant bath whilst water is sprayed into a steam space above the solvent continuously simultaneously with the circulation of a hot air stream through the steam space and a cooler, the water being sprayed as a vapour or mist which serves to maintain a relative humidity of 70 to 100% and the total weight of water being 10 to 100% compared with the weight of the material being cleaned.

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## SPECIFICATION

## Disinfectant dry cleaning method

- 5 In the previously-customary methods of dry cleaning material such as textiles, leather and furs in a solvent bath without a disinfectant, disinfecting of the said material is not achieved; relevant tests show that, on the 10 contrary, the cleaning process can introduce and distribute micro-organisms throughout the material being cleaned.
- 15 The known methods of disinfectant dry cleaning, which are formaldehyde or its derivatives, work in the presence of cleaning intensifiers (see Römpf 7th edition, volume 5, page 2952) which are admixed with the solvent bath, together with small quantities of water. In this respect, to ensure good disinfecting without damaging the material to be cleaned by creasing, matting or shrinking, careful control both of the amount of water in 20 the liquor and of the relative air moisture or humidity in the vapour space or steam space 25 above the bath is necessary. The latter should, for example in the case of the single disinfectant dry cleaning method described in the "List of disinfectant agents and methods tested and approved by the Federal Public 30 Health Department" (Issue of 1st June 1978), not fall below 90 percent.

In the journal "Reiniger—Wäscherei" ("Cleaners—Washers"), issue No. 7/80, page 29, it is expounded that, with cleaning times 35 of 15 minutes during which the relative air moisture in the steam space above the liquor may not fall below 90 percent, the majority of outer clothing worn nowadays felts or matts, so that such cleaning methods are unsuitable 40 for commercial dry cleaning.

German Patent No. 21 08 991 has made known a method which has in the meantime been tested in practice and according to which good cleaning effects can be achieved 45 in a hot air stream, without cleaning intensifiers, only with organic solvent (for example perchloroethylene) and water in a most finely divided form, without disadvantageous impairment (for example, felting) of the material 50 having to be feared.

From the point of view of hygiene, however, this procedure can be equated with the customary cleaning processes, because micro-organisms are neither killed off to an adequate 55 extent, nor is the propagation thereof prevented. If an attempt is made to disinfect in this method by adding formaldehyde, this is not successful, because the initially-high relative air moisture drops to less than 70 percent 60 in a few minutes after the addition of water, ensuing at the start of the cleaning, constrainedly through the condenser incorporated in the system. Because there is considerable air circulation in the steam space (or chamber) of 65 the machine, high relative air moisture can-

not, in practice, be achieved over a fairly long period of time with the conventional dosing equipment. A pre-requisite for a good disinfecting action of the formaldehyde upon the

70 dry cleaning is, however, a constantly high relative air moisture of 80 to 90 percent. We have surprisingly been found that, by observing the follow method steps, both qualitatively high-grade cleaning and excellent di- 75 sinfecting effects are obtained:

1. During the entire cleaning process in a conventional cleaning machine continuously relative large amounts of water, up to 100 percent related to the weight of the material, 80 are sprayed in the form of vapour and/or fine mist into the steam space above the cleaning liquor.

2. By controlled hot air circulation one prevents any damage, which would otherwise 85 perforce occur as a result of the substantial additions of water mentioned under 1 above, to the material to be cleaned by creasing, shrinking or felting. The air circulating in the machine is heated up by way of a heating 90 device and conducted through the steam space above the cleaning liquor. From here it is conducted, for condensation of entrained vapours consisting of organic solvent and wa- 95 ter, by way of a cooler in a closed circuit back to the heating device.

3. By a careful co-ordination of the spray- 100 ing-in-mentioned under 1, of water with the hot air circulation mentioned under 2, at all times the desired high relative air moisture, optimum for disinfecting, is produced in the steam space above the cleaning liquor.

4. The cleaning is performed without the addition of cleaning intensifiers. The known 105 relationships between cleaning intensifiers and water retention thus do not have to be needed, which represents considerable simplification. Surprisingly, excellent cleaning effects have, nevertheless been achieved.

5. At the start of the cleaning process, a 110 suitable disinfectant is added.

The present invention provides, conse- 115 quently, a method of disinfectant dry cleaning in which the material being cleaned is treated without the addition of cleaning intensifiers, in the presence of a disinfectant, with an organic solvent bath, and subsequently the bath liquid is pumped off and the material is spun, option- 120 ally re-rinsed and dried in a hot air flow, characterised in that, during the actual clean- 125 ing operation continuously 10 to 100 percent, preferably 30 to 50 percent, water, related to the weight of the material to be cleaned, is sprayed in the form of vapour and/or a fine mist into the steam space above the cleaning liquor, and at the same time a hot air stream is conducted in such a way, in a closed circuit through the steam space and by way of a subsequent cooling device, that during the 130 cleaning operation at all times a relative air moisture of 70 to 100 percent, preferably 80

- to 90 percent, prevails above the liquor. Low aliphatic chlorohydrocarbons, for example perchloroethylene, are preferably used as organic solvents.
- 5 In carrying the method of the invention into effect, formaldehyde and its derivatives, in the form of formalene or hemiformalene, or chlorine or inorganic or organic substances with active chlorine as its effective component are 10 preferably used as disinfectant.
- Depending on the manner in which the method is carried out, amounts of 0.005 to 0.5% formaldehyde, related to material weight, which corresponds to about 0.0005 15 to 0.05 percent related to the organic solvent, are sufficient. These amounts are sufficient to kill off test germs, namely: *Staphylococcus aureus* SG 511, *Bct. coli*, ATCC 8739, *Pseudomonas aeruginosa*, *Proteus vulgaris* and *Trichophyton mentagrophytes*.
- In order to eliminate residual amounts of formaldehyde on the treated material, post-cleaning treatment of the material being cleaned may be carried out with gaseous 25 ammonia, in order to bind the residual formaldehyde as hexamethylenetetramine. Also re-treatment of the cleaned material can be effected with hydrogen peroxide in the liquor or in the rinsing bath, in order to convert residual amounts of formaldehyde into formic acid. Similar re-treatment with a little hydrogen peroxide to eliminate residual amounts of chlorine can be effected at the end of the 30 cleaning process, if chlorine or inorganic or organic substances with active chlorine as effective ingredient are used as disinfectant.
- The treatment time is governed by practical requirements and lies in the range of 10 to 45 minutes, preferably 20 to 30 minutes. The 35 disinfectant may be added with or shortly after the first addition of water. During the cleaning process, a hot air stream is passed over the solvent bath which has a temperature of 20 to 60°C, preferably 30 to 40°C. This 40 stream is introduced by way of a heating device into the steam space above the cleaning liquor and passes from there, for condensing entrained vapours, consisting of organic solvent and water, by way of a cooler around 45 a closed circuit back to the heating device. What is important is that the addition of water and the hot air circulation conducted by way of the cooler are so co-ordinated to one another that at all times 70 to 100 percent, 50 preferably 80 to 90 percent, relative air moisture prevails in the steam space above the cleaning liquor. In order to avoid any possible damage to the material being cleaned, at the end of the cleaning process, the hot air circulation 55 is maintained without further spraying-in of water for a little longer, for example 3 minutes. Subsequently the bath liquid is pumped off, the material to be cleaned is spun, possibly re-rinsed, and dried in the hot 60 air stream.
- In the literature, reference is frequently made to smell obtrusion when disinfecting with formaldehyde. By virtue of the relatively small amounts of formaldehyde used in the 65 described method of disinfectant dry cleaning, only minimum amounts of formaldehyde adhere to the material being cleaned, at the end of the process, according to present experience. These amounts can, as already stated, 70 easily be eliminated by steaming, by re-treatment with a little gaseous ammonia (with the formation of hexamethylenetetramine) or by oxidation into formic acid with, for example, hydrogen peroxide, at the end of the cleaning 75 process.
- Besides formaldehyde, chlorine is also a suitable disinfectant. This can be offered very simply in the form of commercially-available soda bleaching lye which contains about 15 80 percent active chlorine/litre. In order to avoid damage to the material being cleaned, maximum amounts of 0.3 percent active chlorine, related to the material weight, should not be exceeded.
- 90 The invention is illustrated in more detail in the following example:-
- A conventional cleaning machine is provided with a device for feeding steam into a steam space above cleaning liquor in the machine.
- 95 In the machine there is a blower with the aid of which air circulation can be caused. With this, air can be blown, by way of a heating device, into the steam space above the cleaning liquor and returned from there by way of 100 a cooler (where entrained vapours, consisting of perchloroethylene and water, condense) back to the heating device in a closed circuit. 25 kg of men's outer clothing, consisting of pure wool and mixtures of wool with customary synthetic fibres, are filled into the drum of 105 the machine. Fixed to various items of clothing are small bags in which are contained tabs or pads carrying test germs. These consist of *staphylococcus aureus* SG 511, *Bct. coli* 110 ATCC 8739, *Pseudomonas aeruginosa*, *Proteus vulgaris* and *Trichophyton mentagrophytes*. After introduction of the articles of clothing into the machine, 130 litres of perchloroethylene are added, and the drum is 115 driven rotationally. As soon as the articles of clothing are impregnated with perchloroethylene, the hot air circulation is switched on and water vapour (or steam) is sprayed in. Simultaneously with the first addition of steam, 400 120 ml of an aqueous solution, which contains 50 g of formaldehyde (0.2 percent related to the weight of the material), are sprayed in. In total, in the course of about 30 minutes continuously 12.5 kg of steam (50 percent 125 related to material weight) are sprayed in, as a result of which a relative air moisture of 80 to 85 percent prevails in the steam space above the liquor. Through the co-ordination of the hot air circulation with the continuous addition of steam it is ensured that the indicated 130

air moisture is constantly maintained. After the last addition of steam, the drum is caused to rotate, with continued hot air circulation, for a further 3 minutes. After that one pumps 5 and spins off the cleaning liquor, re-rinses with 130 litres of fresh distilled perchloroethylene for 4 minutes, spins off once more and dries the material in the hot air stream. After blowing-out with fresh air, the machine is 10 emptied and the small tabs or pads carrying the test germs are removed from the small bags fixed to the items of clothing. Re-cultures show that all of the test germs are dead. The cleaned and disinfected articles of cloth- 15 ing are clean and neither felted nor shrunk.

#### CLAIMS

1. A disinfectant dry cleaning method in which material to be cleaned is treated with- 20 out the addition of cleaning intensifiers, in the presence of a disinfectant, with an organic solvent bath, and subsequently the bath liquid is pumped off and the material is spun, optionally re-rinsed and dried in a hot air stream, 25 characterised in that, during the actual cleaning operation, continuously 10 to 100 percent water, related to the weight of the material to be cleaned, is sprayed in the form of vapour and/or a fine mist into the steam space above 30 the cleaning liquor, and at the same time a hot air stream is conducted in such a way, in a closed circuit through the steam space and via a subsequent cooling device, that during the cleaning operation at all times a relative 35 air moisture of 70 to 100 percent prevails above the liquor.
2. A cleaning method as claimed in claim 1, characterised in that low aliphatic chlorohydrocarbons are used as the organic solvent 40 bath.
3. A cleaning method as claimed in claim 1 or 2, characterised in that formaldehyde and/or chlorine and/or inorganic or organic substances containing active chlorine as its 45 active component, is used as disinfectant.
4. A disinfectant dry cleaning method as claimed in claim 1 and substantially as herein described by way of example.
5. Material which has been dry cleaned by 50 the method of any of claims 1 to 4.